m/035/002

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DIV. OF OIL, GAS & MINING

DOGM REVIEW COMMENTS
KUCC'S BINGHAM CANYON MINE 2003 RECLAMATION & WATER MANAGEMENT PLAN
DOGM Review Comments
(March 19, 2003)

KENNECOTT UTAH COPPER CORPORATION (KENNECOTT) COMMENT RESPONSES ARE UNDERLINED.

Page 14 – last paragraph
This paragraph states that as an amendment KUC would consider the use of "pure biosolids".
Please clarify what constitutes a pure biosolid. (DJ)

Text has been added in Sections 2.3, 4.4.2 and 4.4.5 to explain that "if biosolids have been mixed with woodchips or another carbon source, the application rate of the mixture may be as high as 30 dry tons/acre, as long as the biosolids component of the mixture does not exceed 10 dry tons/acre".

Page 28 – Section 3.4 – second paragraph
"Shaft, adit and tunnel portals within the pit area will be sealed or gated."
The closure or guarding of all shafts, adits or tunnel portals within the mine permit area should be considered. (DJ)

Text has been added to Section 2.3 stating that "shaft, adit and tunnel portals that are both within the permit boundaries and on Kennecott property will be assessed to determine if they would pose a risk to the public after closure. Those portals identified as a risk by the hazard assessment will be gated or sealed".

Page 29 – 3rd paragraph
The plan states that if a pit lake is allowed to form, lime or another neutralizing agent will be added if required in order to maintain a circumneutral pH and minimize metals solubility during flooding.
It has been documented that pit lakes are normally strongly stratified due to elevated temperatures and low conductivity of surface waters. How will KUC assure the neutralizing agents will be thoroughly mixed? The addition of Hydroxide sludge has been documented to sink rapidly to the lake bottom leading to elevated levels of dissolved oxygen and total metals. (DJ)

Text has been added to Section 3.4 stating that "if neutralizing agents are used, they will be added in a manner that assures appropriate mixing".

Page 39 – first bulleted item
Ensure that catastrophic events cannot compromise the water collection systems for transporting contaminated water and sediment off KUCC property.

No DOGM comment listed but please refer to Page 38-first paragraph response below.

Page 38 – first paragraph
Precipitation greater than the 25 year, 24 hour storm event (the minimum system requirements specified by the storm water regulations) that falls on the slopes may also exceed the capacity of some down gradient water and sediment collection systems.
How can KUC ensure that catastrophic events will not compromise the water collection systems when they admit that the event is a possibility? (DJ)

The Eastside collection system was designed in accordance with storm water regulations and with State approval to handle at least 25-year, 24-hour storm events. Significantly larger events may exceed the capacity of portions of the collection system. However, the risk of an event that exceeds the capacity of the water collection system and transports water or sediment off the property is generally limited to the tributary drainages of Butterfield Creek. This is the only location where such events have occurred since the Eastside Collection system was upgraded in the mid-1990s. Although the water management system in the tributary drainages has been further up-graded since these releases, Kennecott acknowledges the additional need for a slope stabilization study on the angle of repose slopes of the waste rock dumps in the Butterfield tributary drainages. The text in Section 4.0 has been modified to clarify this reasoning.

Page 44 - Section 4.4.4
The plan states that KUC is presently completing a slope stabilization study on 200 acres of dumps that have angle of repose slopes that range from 700 to 900 feet.
If the reduction of these slope angles proves feasible, the studies should be applied to the ~1200-foot angle of repose slopes that face the Salt Lake Valley. KUC should undertake studies of these features to assess the practicality of long-term stabilization. The Division is concerned with the safety and stability of these dump slopes. The 1976 approved plan states that dumps will be left "safe and stable;" KUC has not demonstrated any long-term stability of these features. (DJ)

Kennecott intends to undertake additional slope stability studies of the north Eastside dump angle of repose slopes before closure. Text has been added to Section 4.4.6 stating "if additional stability assessments identify slopes that pose a significant risk of offsite waste rock or contaminant transport ..... some of these slopes will be partially or fully reclaimed at closure".

Page 46 – Section 4.4.5
"Cross-ripping will be shallow enough to avoid mixing waste rock into cap material."
To insure the stability of the cap material, some roughening of the waste rock should be performed before the placement of the cap material. Because recontoured slopes will

form a slip plane between the waste rock and the overlying cap material that could result in slumping of the cap material during storm events. (DJ)

Text has been added to Section 4.4.5 stating that "the outer dump face will be cross-ripped or otherwise roughened before placement of the growth media".

Page 48 – Second paragraph
None of these slopes pose a significant risk of contaminant transport off the property—
On page 36—the last paragraph concerning the high dumps facing the Salt Lake Valley says, "Precipitation greater than the 25-year, 24-hour storm event (the minimum requirements specified by the storm water regulations) that falls on the slopes may also exceed the capacity of some down gradient storm water and sediment collection systems."
These two statements seem to contradict each other, which statement is correct? (DJ)

See response to DOGM comment for page 38 – first paragraph above.

R647-4-113.3 Surety

In 1976, Kennecott Utah Copper Corporation proposed and entered into a Self-bonding Reclamation Contract with the Board of Oil, Gas and Mining as the form of reclamation surety for the Bingham Canyon Mine. That agreement continues to remain in effect. The original permit application contains a number of possible reclamation scenarios that might be followed depending upon the site conditions and other circumstances at closure and the advances made in reclamation technologies over the years. Very little design detail was provided in the original reclamation plan, therefore it was difficult, if not impossible, to prepare a reasonably accurate reclamation cost estimate. The Bingham Canyon Mine is the only self-bonded permit that does not have a reclamation cost estimate associated with the contract.

More recently, significant enhancements have been made to the Bingham Canyon Reclamation Plan that outline more definitive closure and reclamation design details. Accordingly, it is our opinion that a reasonable reclamation cost estimate can now be developed.
We request that KUCC prepare and submit an engineering-based reclamation cost estimate that the Division can use to generate a state-based reclamation estimate for the Bingham Canyon Mine permit.

Kennecott intends to submit a cost estimate for planned closure and reclamation activities covered by DOGM permit M/035/002. This estimate will be provided as supporting information for Kennecott's self-bonding contract with the Board of Oil, Gas and Mining. The estimate is still being developed and will likely not be available before 2004.

Page 58 – Second and third paragraphs
Second paragraph states that on the mass basis, it is estimated that less than 10 percent of the South Impoundment material has the potential to become acidic. The third paragraph

states, "Based upon the data collected between 1994 and 1996 and the new NAG test results, approximately 50% of the tailings exposed on the embankment surfaces have the potential to acidify over the long term."

The total area of the impoundment is 5800 acres of which 2300 acres is embankment. If 50% of the embankment has the potential to acidify that would equate to ~20% of the total impoundment has the potential to acidify. (DJ)

The majority of the tailings mass will not have the potential to become acidic because of either its NNP characteristics or because it will be saturated in perpetuity, restricting oxygen access. The text in Section 8.0 has been modified to clarify this point.

Table 10-2 identifies "Summary of the Water Management Facilities that are Anticipated to be left in Place at Closure"
The table lists the anticipated structures, but does not indicate where these structures will be located and how they will be designed?" It is our opinion that the design details associated with each of the structures identified in Table 10 are a necessary part of evaluating the reclamation success of the Bingham Canyon Mine.
The Division requests a map showing the tentative location of these structures. The engineering criteria for these structures is unknown at this time but the key to approval of these structures is their stability, so any engineering criteria should be centered around a design concept using flow rates or design storms to verify designs. (TM)

Most of these facilities currently exist and are located on maps that are already included with the plan. Table 10-2 has been modified to identify the appropriate map and the facility locations on the maps. Many of the new facilities that will be constructed between now and closure can only be approximately located because of the many variables that are not currently know such as: 1) the location of extractable clean water resources above the open pit, 2) the location of seeps and springs on the ultimate pit walls, 3) base flows and water quality at closure, and 4) the final design of the plume remediation project. Also please see the response to the comment for page 65 and Section 10.0 below.

We realize that some of these structures are currently in place, like the cut-off walls, collection sumps, etc. However, the majority of the post-closure water management structures are not built yet and the plan does not include a projected timeframe when these structures will be designed and submitted for our review. It is mentioned on page 64 that "tentative reclamation activities have been selected based upon the existing incomplete data set." This statement does not define what that data set is.
Please provide more detail regarding this data set and what it encompasses. (TM)

The data requirements that are needed for the final design of the Excess Water Management Area (Section 9.0) are already listed in Section 9.3.

It is stated on page 65 and section 10.0, Post-Closure Water Management, that after closure the surface and groundwater flows will be captured and managed in perpetuity. This statement raises the following questions:

1. *Who will manage and maintain these post-closure water treatment structures "in perpetuity" and how will the long-term maintenance requirements for these structures be funded?*

See response to comment under Surety above.

2. *The design parameters for all structures (pipes, collection sumps, ponds and ditches, cutoff walls, horizontal drains, shallow wells, etc.) listed in Table 10 as being in place for perpetuity are not identified Who will manage. We request that a schedule be submitted that will identify when Kennecott anticipates submitting the design plans for these structures to the Division.*

3. *It is appropriate for surface water diversions, ponds, etc., that will remain in place for perpetuity, to be designed for the 100 year, 24 hour storm event. Any storage impoundments with spillways should also be designed according to the same criteria. (TM)*

Most of the structures that will be used for long-term water management are already in place and were designed with approval from the State Engineer, the State Division of Water Quality, the State Division of Environmental Response and Remediation and the Federal Environmental Protection Agency. The majority of structures yet to be constructed for water management purposes between now and closure are related to the Bingham Plume remediation and will need to be approved by the CERCLA Technical Review Committee. DOGM personnel are currently represented on this committee, and Kennecott believes that this is the appropriate venue for DOGM to review and comment on system designs. The remaining structures that will need to be constructed between now and closure are related to water segregation and handling above the waste rock dumps and in the Bingham Pit. These structures will be described in detail in the final water management closure plan required by the State Division of Water Quality at least one year before closure. Kennecott proposes to provide DOGM with a copy of this plan when it is completed.

Wells exist throughout the property and their disposition is not clearly identified. The life of monitoring the wells could be for a short period, 30 years, in perpetuity, or some time period in between. We have not received a detailed closure plan for these wells. We request that the closure design criteria be spelled out and that the methods to close these wells comply with the State Engineer's specifications when the time comes. *This following closure information must be documented with the Division of Oil, Gas, and Mining within a year of closure of the mine.*

1. *We request that all wells within the Bingham Mine Permit boundary be grouped by ownership, monitoring criteria and by anticipated closure date.*

2. *A detailed explanation of the well closure protocol should be included in the plan regarding all wells that are under Kennecott ownership. (TM)*

The text in Section 10.2.5 has been modified to confirm that all wells will be abandoned in accordance with the State Engineer's specifications when the wells are no longer usable, needed or required. Kennecott will provide DOGM with copies of the long-term closure and monitoring plans that will likely be required by the Groundwater Discharge permits managed by the State Division of Water Quality after closure. A list of existing wells and wells planned for abandonment will also be provided within a year of closure.

Page 14.
For areas where structures are demolished, this section says that if the existing soils or fill materials do not provide a suitable growth media, topsoil will be imported and spread to a minimum depth of six inches. Six inches of soil will not provide adequate rooting depth over unsuitable soils or fill materials. There needs to be at least 2-3 feet of growth medium for plants to become established and persist.
Therefore, the plan should be revised to indicate that in those areas where structures are demolished and where existing soils or fill material do not provide a suitable growth medium, KUCC will either import soils or amend the existing soils so there is at least 2-3 feet of rooting medium, including six inches of topsoil. (PBB)

Text has been added to Section 2.3 to state that "subsoil will also be imported in addition to topsoil if required to provide a minimum of two feet of rooting media".

Page 30 - This section addresses pit reclamation.
The plan says no reclamation work will be done on the benches because most are not safely accessible, and it also says seed will be broadcast except in areas where there is a nearby seed source.
Although most of the benches may not be safely accessible, those that are accessible should be ripped. The Division's experience is that natural revegetation is often very slow and may result in weed establishment. Therefore all areas where revegetation may be possible should to be seeded. (PBB)

The text in Section 3.4.2 has been modified to clarify that all safely accessible pit benches above the pyrite halo will be ripped.

Figures 4-4 and 4-5, page 35. and Figure 4-1.
Electrical conductivity values less than about 4 mmhos/cm are not generally limiting to growth of wildland species, but Figures 4-4 and 4-5 clearly show a marked reduction above 0.5. We are not sure if there's some kind of interaction between the EC and something else or what the problem might be, but it's unlikely the EC by itself is causing this reduction in plant growth.

The Kennecott laboratory has analyzed paste conductivity on the waste rock soils using a 1:1 soil to water mixture. Most of the salinity tolerance data reported in the literature

reports the salinity of a saturation extract. Twenty-two samples were recently analyzed at the laboratory by the two techniques and it was determined that the saturation extract conductivity = 1.9 times the 1:1 conductivity. This indicates that saturation extract conductivity would limit growth of many of the native species in the range of 1000 to 1500 uS/cm. The literature commonly cites 1200 uS/cm as the point where salt sensitive species begin to exhibit salinity stress, so the data are in relatively good agreement. Text has been added to Section 4.0 that addresses this issue.

Would biosolids help? Have some of the more salt tolerant species that still grow at higher elevations, like fourwing saltbush, slender wheatgrass, tall wheatgrass, or pubescent wheatgrass, been tried?
Where pH values are above 5 and EC values are between about 0.5 and 4 mmohs/cm, some plots to test revegetation methods may be appropriate. (PBB)

Fourwing saltbush has only been successful below about 6000 feet in elevation. The wheatgrass species currently listed have been included in the seed mixes used at higher elevations with some success. Biosolids applied to saline dump surfaces have appeared to favor the establishment of salt tolerant weed species.

There are some areas shown on Figure 4-1 where it appears the pH and EC values fit the criteria for revegetation but where direct planting is not planned. The plan indicates these areas may have adverse physical characteristics and that is why they are not included in the revegetation areas.
Are there ways of remediating these physical problems? Deep ripping should take care of many of the compaction problems and may also bring up fines in areas with high percentages of gravel. Areas with high percentages of gravel might also benefit from biosolids (PBB).

Text has been added to the legend of Figure 4-1explaining that "Sample sites with favorable soil chemistry that are outside these green boundaries are only representative of very small areas that are surrounded by unfavorable surfaces. These types of sites commonly include single end-dump piles that were sampled."

It would be helpful to know why some of the areas outlined in Figure 4-1 are not included in the "green."
If possible, we request that KUCC identify compacted areas and areas of high gravel content on this map. (PBB)

See comment above.

Where slopes are recontoured, but not revegetated, KUCC anticipates the waste rock will weather and that vegetation will eventually become established.
KUCC needs to have a very active program to control noxious weeds so they don't spread into these areas. (PBB)

The only noxious weed that is dominant and widely distributed on waste rock surfaces with favorable soil chemistry is Dalmatian Toadflax. Kennecott is currently investigating potential biological control methods for this species.

Page 57.
The acreage figures given for the South Tailings Impoundment are confusing. The plan indicates that 2000 acres are disturbed, but then goes on to describe 5800 acres of disturbance.
How much acreage is currently disturbed? Please clarify these statements. (PBB)

The text in Section 8.0 has been clarified to state that "the original footprint of the impoundment was about 5800 acres, of which less than 2000 acres are currently not reclaimed".

Pages 32 and 61.
The selenium values of 1.2 and 2.1 ppm are very high if this is hot water extractable selenium. It is assumed that it is total selenium in which case the numbers are not helpful in determining whether there could be toxicity to wildlife.
Please clarify the accuracy of these measurements. (PBB)

The text in Sections 4.0 and 8.0 has been modified to state that these are total metals concentrations. The results of SPLP tests on the tailings has also been added to Section 8.0.

Page 62.
At the mine, the Division can envision salt being leached from the waste rock, but in the tailings impoundment, we see salts staying in the ponds and possibly concentrating on the surface. The plan says final reclamation may need to be delayed to allow salts to be removed by precipitation, infiltration, and runoff.
Will natural precipitation events actually remove the salts? What is KUCC's justification for this statement and how long of a delay is anticipated before reclamation is performed? (PBB)

Text has been added to Section 8.2 stating that "Recent sampling and historical studies indicate that this natural leaching process likely occurs within several years on the embankment surface and on portions of the interior, but it may involve decades on portions of the flat interior surface underlain by very saline, very fine-grained tailings (Utah State University, 1974)."

The plan says it may not be possible to establish vegetation on some very saline interior surfaces in which case other permanent stabilization methods may be needed. The methods mentioned are capping with a growth medium, capping with coarse material, or promoting the formation of salt crusts.
It may be possible to establish vegetation in some of these areas by using a capillary barrier (coarse material) overlain by a growth medium. (PBB)

The 1976 Mining and Reclamation Plan requires that the interior surfaces of the impoundment be stabilized. Kennecott agrees that "capping with a growth media underlain by a capillary break" is a potential stabilization method so it has been added to the list in Section 8.2.

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